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New locality records and range extensions for several threatened species of Odonata in Sri Lanka

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Abstract: Sri Lanka is a tropical island nation with a rich Odonata fauna. About 50% of the recorded species from the country are currently known to be threatened with extinction at the national level. Many threatened species and newly discovered Odonata species in Sri Lanka lack reliable faunistic data, which is highly important for proper conservation assessments. An ongoing island wide Odonata survey was conducted opportunistically using visual encounter surveys that resulted in faunistic observations for over 80% of known species. We report 24 faunistic observations that result in range extensions for 10 species threatened with extinction, according to the findings of this ongoing survey. These records provide a better understanding of the current distribution of species, thus providing valuable information for future conservation assessments.

Key words: faunistic records; range extension; threatened Odonata; Sri Lanka

Sri Lanka is home to 121 species of Odonata with a valid taxonomic description (Bedjanič et al. 2014; Priyadarshana et al. 2015). These belong to 12 families and 67 genera (Bedjanič et al. 2014; Priyadarshana et al. 2015). Of the species that have been recorded, 47 are known to be endemic to the island. Recent studies have reported that several other species of Odonata are currently in the process of being taxonomically described (van der Poorten and Conniff 2012; Bedjanič et al. 2014).

Even though new species continue to be described from Sri Lanka, there are gaps in the current knowledge of ecology and distribution of these fauna, especially regarding endemic and threatened species. Recent work by Bedjanič et al. (2014) compiled historical faunistic records and recent survey findings, documenting the distribution of Sri Lankan Odonata. However, there are many species with few recorded observations, thus their actual distribution ranges need more research.

Distribution range is an important criterion that has been used in determining National Conservation Status (NCS) of the Sri Lankan odonate fauna. According to the latest national conservation status assessment of Odonata, which followed IUCN Red List categories and criteria version 3.1, there are 61 threatened species (including 40 endemics) and 11 data deficient species (including nine endemics) in Sri Lanka (MOE 2012). An independent assessment carried out by Bedjanič et al. (2014) using a more complete data set and assessing the conservation status of endemic Sri Lankan Odonata listed 39 threatened endemic species and two data deficient endemics. As extent of occurrence (EOO) and area of occupancy (AOO) are the key measures in criterion B of IUCN Red List Categories and Criteria Version 3.1 (IUCN 2012), the more observations of a particular species from different localities the more accurate their conservation status, as EOO and AOO increase with increasing number of faunistic records. The results of the conservation assessment by Bedjanič et al. (2014) have been proposed as the Global Conservation Status (GCS) assessment for Sri Lankan endemic Odonata (Bedjanič et al. 2014).

Understanding the distribution range of a species is critical to determine conservation priorities, plan further studies, and design conservation actions. This is particularly important for poorly known species, such as endemics under extinction risk and recently described species without reliable data. Here, we report new locality records for 10 poorly known species of Odonata, ensuring a better conservation assessment of the taxa and providing a better opportunity for the in-situ conservation of threatened species in the future.

Surveys were carried out as a part of an ongoing island wide survey to document the current distribution of Odonata in Sri Lanka. Locations were surveyed opportunistically. Observations were made using

visual encounter survey method and specimens were identified in the field using morphological characters. No specimens were collected. Photographs were taken to confirm identifications by comparison with the most updated literature (de Fonseka 2000; Bedjanič et al. 2006, 2014; van der Poorten 2009, 2012; Bedjanič 2013; Conniff and Bedjanič 2013). Locations were recorded either by using handheld GPS receiver units or using Google Earth™ software. Published distribution records (Bedjanič et al. 2014; Udagedara and Kularatne 2015) were used to create the previously known distribution ranges for the maps.

National conservation status of each recorded species was assigned according to the National Red List 2012 of Sri Lanka (MOE 2012). Current Global Conservation Status (Bedjanič 2006, 2009; Dow 2009; IUCN 2015) and the Proposed Global Conservation Status by Bedjanič et al. (2014) are also listed for each species.

The surveys resulted in distribution records for over 80% of the Odonata species that have been recorded in Sri Lanka with new records on very rare and highly threatened species. This paper presents the records that extend the known distribution of 10 highly threatened species (Table 1).

Table 1. Observations on the Odonata species recorded (FR=Forest Reserve, NP=National Park, PR=Proposed Reserve).

Species	Date	Location	Elevation (m)	Distance to the nearest previously known locality (km)	Notes
Libellago corbeti	17 May 2014	Yagirala FR 06.3785° N, 080.1630° E	109	17	Lowest known elevation for the species
Libellago corbeti	2 August 2014	Yagirala FR 06.3719° N, 080.1711° E	126	16	
Libellago corbeti	9 November 2014	Makandawa FR 06.9870° N, 080.4028° E	123	52	First record from Kegalle District
Indolestes divisus	13 November 2013	Wilpattu NP 08.4108° N, 080.0266° E	78	94	First record from North-central province
Indolestes divisus	14 April 2015	Hakmana 06.0954° N, 080.6458° E	58	73	First record from Southern Province
Archibasis lieftincki	29 September 2012	Pahiyangala 06.6456° N, 080.2178° E	48	30	First record from Western Province and Kalutara District
Archibasis lieftincki	2 August 2015	Thotaha, Walallawita 06.3647° N, 080.1860° E	19	29	
Archibasis lieftincki	24 August 2013	Indikada Mukalana, Waga 06.8966° N, 080.1635° E	122	52	First record from Colombo District
Ceylonosticta hilaris	27 April 2013	Riverston, Knuckles Mountain FR 07.5229° N, 080.7335° E	1,320	51	First record from Knuckles Mountain Range and Matale District
Paragomphus campestris	17 May 2013	Orubandisiyambalawa 07.7384° N, 080.8134° E	121	44	First record from Central Province
Paragomphus campestris	21 May 2015	Pathaha 06.7058° N, 080.9091° E	238	70	First record from Badulla District
Paragomphus campestris	23 May 2015	Pathaha 06.6938° N, 080.9126° E	177	71	
Macromia zeylanica	25 August 2013	Gal Oya NP 07.1903° N, 081.3688° E	189	40	First record from Monaragala district after 1970 and Uva province after 1975
Macromidia donaldi pethiyagodai	12 July 2014	Morapitiya-Runakanda FR 06.4551° N, 080.3255° E	110	10	First record from Western Province
Macromidia donaldi pethiyagodai	23 June 2015	Dombagaskanda FR 06.7256° N, 080.1586° E	31	26	Lowest known elevation for the species
Macromidia donaldi pethiyagodai	7 July 2015	Madakada FR 06.7543° N, 080.1878° E	58	24	
Macromidia donaldi pethiyagodai	31 July 2015	Makandawa FR 06.9873° N, 080.4038° E	121	2	
Tetrathemis yerburii	19 March 2015	Gal Oya NP 07.1942° N, 081.4108° E	117	74	First record from Uva province and easternmost record for the species
Hylaeothemis fruhstorferi	24 August 2014	Makandawa FR 06.9873° N, 080.4038° E	121	50	First record from Kegalle District
Hylaeothemis fruhstorferi	11 April 2015	Adawikanda, Erathna 06.8353° N, 080.4287° E	484	40	
Hylaeothemis fruhstorferi	18 July 2015	Kalugala PR 06.4451° N, 080.2532° E	136	18	First record from Kalutara District
Hylaeothemis fruhstorferi	1 August 2015	Yagirala FR 06.3765° N, 080.1686° E	108	28	Lowest elevation record for the species
Cratilla lineata calverti	9 February 2013	Ritigala 08.0922° N, 080.6809° E	192	88	First record from the dry zone and North Central Province
Cratilla lineata calverti	14 April 2015	Hakmana 06.0954° N, 080.6458° E	58	64	First record from Southern Province

Libellago corbeti van der Poorten, 2009 – endemic

NCS: Critically Endangered (MOE 2012)

GCS: Not Evaluated (IUCN 2015)

Proposed GCS: Endangered (Bedjanič et al. 2014)

Libellago corbeti (Figure 1) is a recently described damselfly in the family Chlorocyphidae. It is a small, black damselfly with some yellow markings. Males of this species can be easily identified, as it is the only Sri Lankan *Libellago* species that does not have a humeral stripe. *Libellago corbeti* is known from lowland rainforest streams in the southwestern wet zone of Sri Lanka (van der Poorten 2009, 2011; Bedjanič et al. 2014). Records presented here (Figure 2) are from Yagirala Forest Reserve (Kalutara district) and Makandawa Forest Reserve (Kegalle district). A single male was sighted at Makandawa Forest Reserve while males, females and oviposition were recorded from Yagirala Forest Reserve.

Figure 1. *Libellago corbeti* ♂.

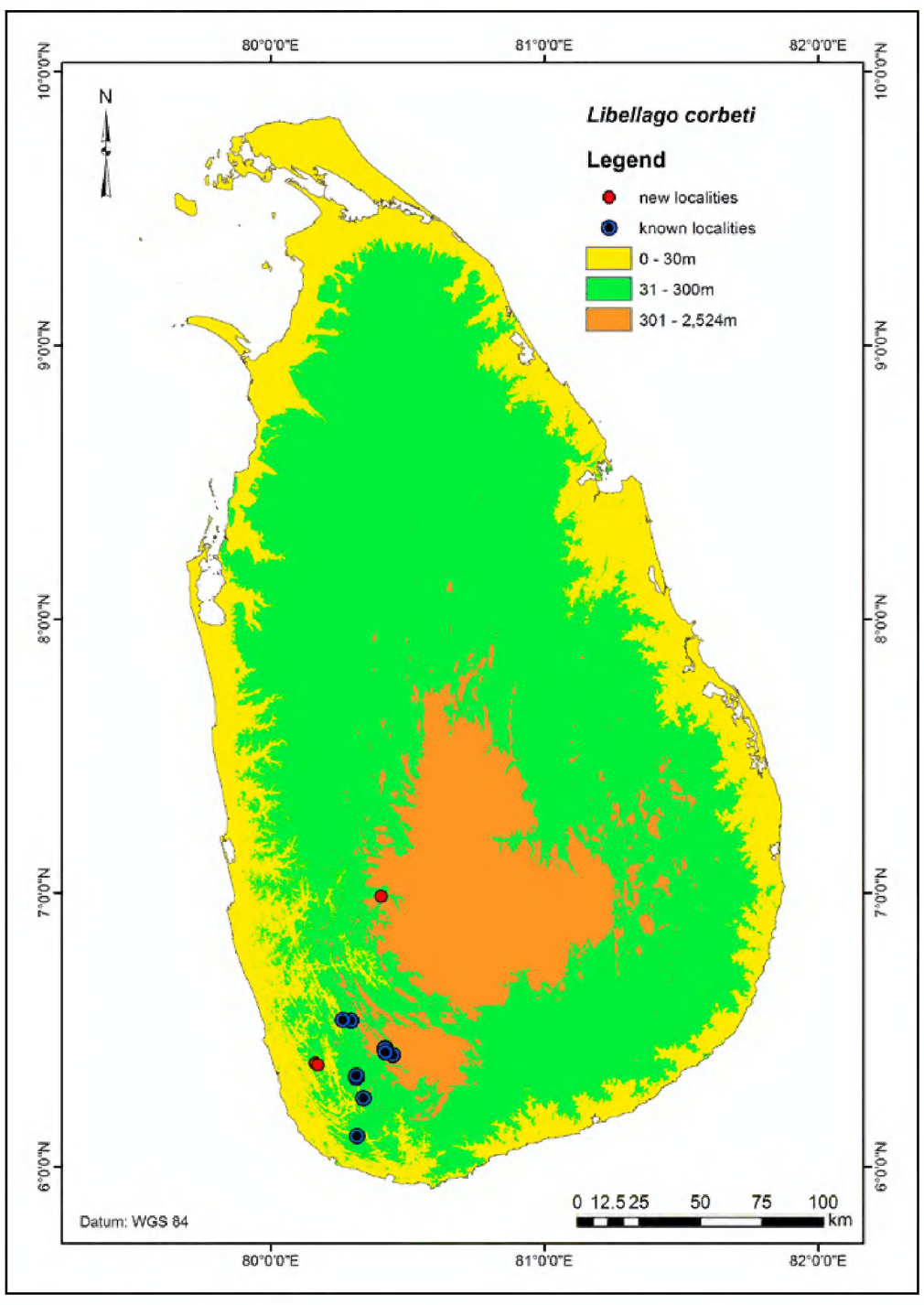

Figure 2. Distribution of *Libellago corbeti* with new localities.

Indolestes divisus (Hagen, 1862) – endemic

NCS: Endangered (MOE 2012)

GCS: Not Evaluated (IUCN 2015)

Proposed GCS: Endangered (Bedjanič et al. 2014)

Indolestes divisus (Figure 3) in the family Lestidae is distributed in the low country intermediate zone and the hill country of Sri Lanka (Bedjaničet al. 2014). It is an uncommon species that inhabits marshes and pools with riparian vegetation. This species can be identified using the colour patterns on abdominal segment 9 and the structure of the male's anal appendages. A single *Indolestes divisus* male was sighted at a small water body located inside the dry-mix evergreen forest in Wilpattu National Park (Anuradhapura district). Another male was recorded from a forested home garden in Hakmana, Matara district (Figure 4).

Figure 3. *Indolestes divisus* ♂.

Archibasis lieftincki Conniff & Bedjanič, 2013 – endemic

NCS: Not Evaluated by MOE (2012)

GCS: Not Evaluated (IUCN 2015)

Proposed GCS: Endangered (Bedjanič et al. 2014)

Archibasis lieftincki (Figure 5) is a recently described species of the Coenagrionidae. It can be distinguished from the only other Sri Lankan representative of the genus by the male's short inferior anal appendages (Conniff and Bedjanič 2013). The records presented here (Figure 6) were made at Pahiyangala (Kalutara district), Indikada Mukalana (Colombo district) and Thotaha, Walallawita (Kalutara district) where single males were sighted perching on vegetation along shaded and slow flowing streams.

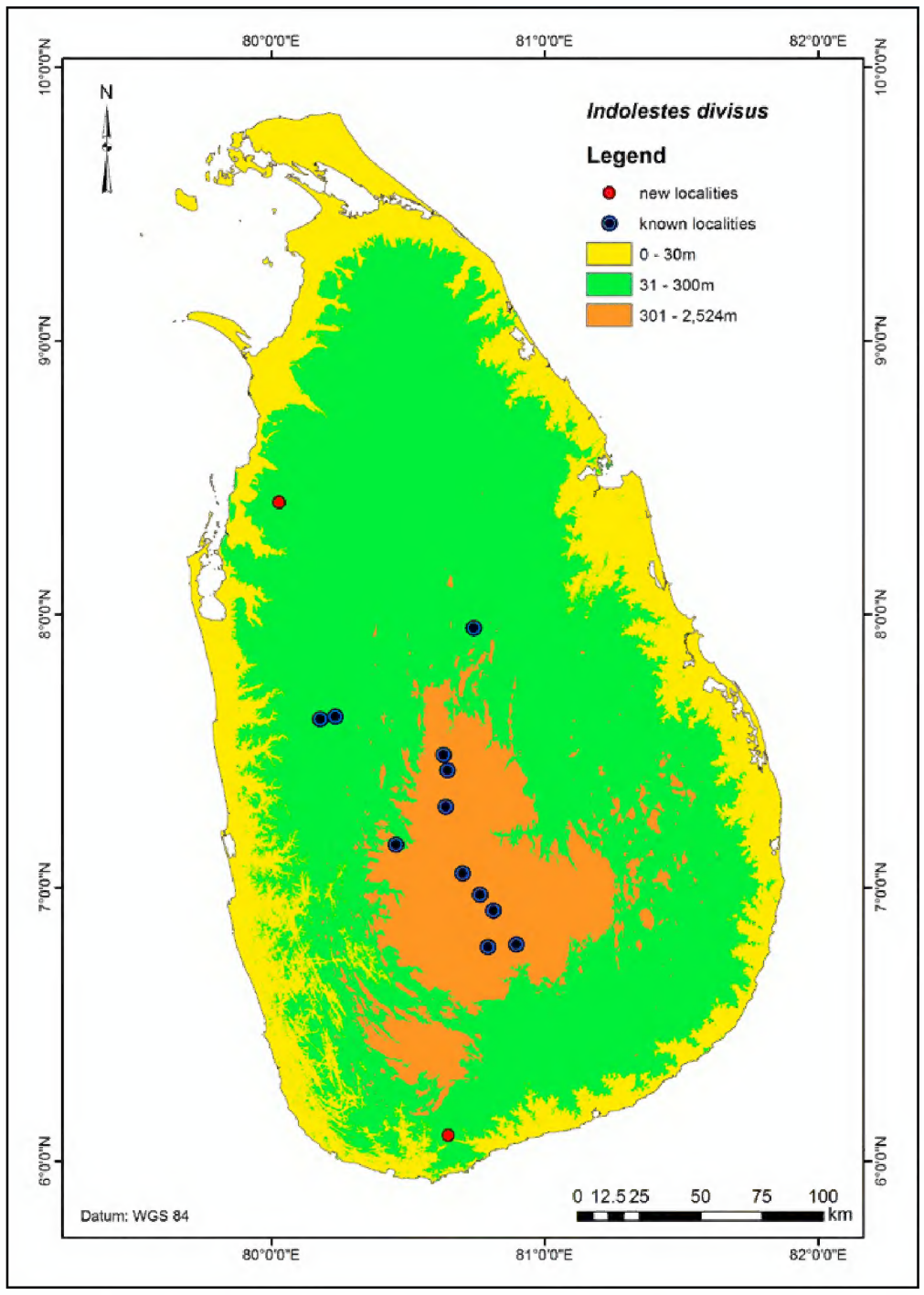

Figure 4. Distribution of *Indolestes divisus* with new localities.

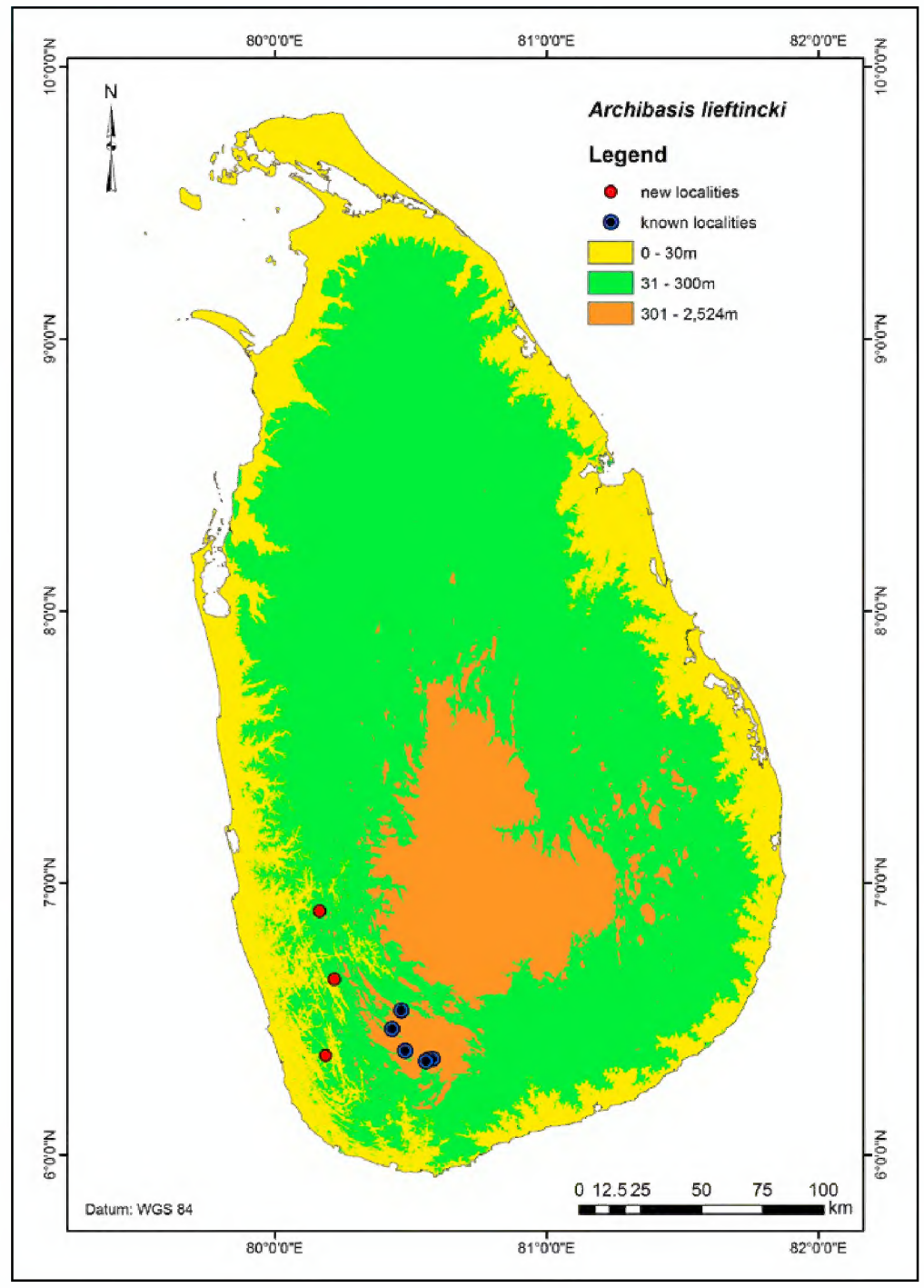

Figure 6. Distribution of *Archibasis lieftincki* with new localities.

Figure 5. *Archibasis lieftincki* ♂.

Ceylonosticta hilaris (Hagen, 1860) – endemic
NCS: Critically Endangered (MOE 2012)
GCS: Critically Endangered (Bedjanič2009)
Proposed GCS: Endangered (Bedjanič et al. 2014)

This rare species belongs to the family Platystictidae and has a distribution in the montane zones of Sri Lanka between 500–1,400 m. It has been recorded from both the central hills and Rakwana mountain range. The field identification of the species is based on the golden yellow median lobe in the prothorax, a golden yellow thoracic stripe and light blue markings restricted to the last three abdominal segments (Bedjanič et al. 2014). A single *Ceylonosticta hilaris* male (Figure 7) was recorded near a small seepage running along the road leading to the Riverston mountain peak (Matale district) on the northern flank of Knuckles Mountain Forest Range (Figure 8).

Paragomphus campestris Bedjanič, 2013 – endemic
NCS: Not Evaluated by MOE (2012)
GCS: Not Evaluated (IUCN 2015)
Proposed GCS: Vulnerable (Bedjanič et al. 2014)

This is a recently described gomphid. It has been recorded from several locations in the dry zone along rivers (Bedjanič 2013; Bedjanič et al. 2014). This species (Figure 9) can be distinguished in the field from the only other Sri Lankan *Paragomphus* by the presence of two pairs of yellow spots on abdominal segments 3–7, a narrow humeral stripe, more curved superior anal appendages and shorter and strongly up-turned inferior anal appendages (Bedjanič 2013). The records presented here (Figure 10) were made on the bank of Amban Ganga (Amban river) at Orubandisiyambalawa (Matale district) where one male was sighted and at two locations in Pathaha (Badulla district) where three males and one female were sighted. The male observed at Orubandisiyambalawa was perched on a boulder and the males observed at Pathaha were perched either on a

Figure 7. *Ceylonosticta hilaris* ♂.

Figure 9. *Paragomphus campestris* ♂.

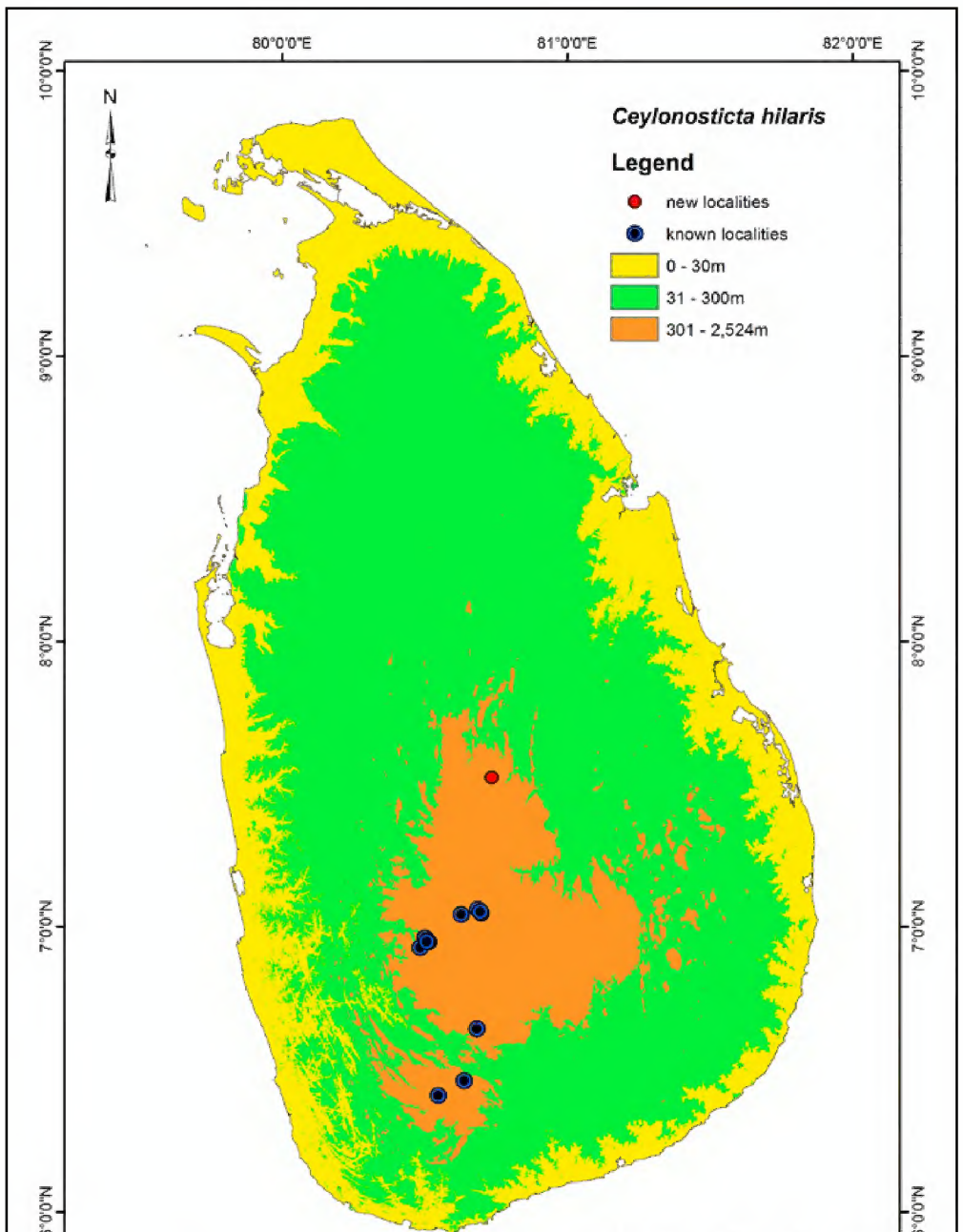

Figure 8. Distribution of *Ceylonosticta hilaris* with new localities.

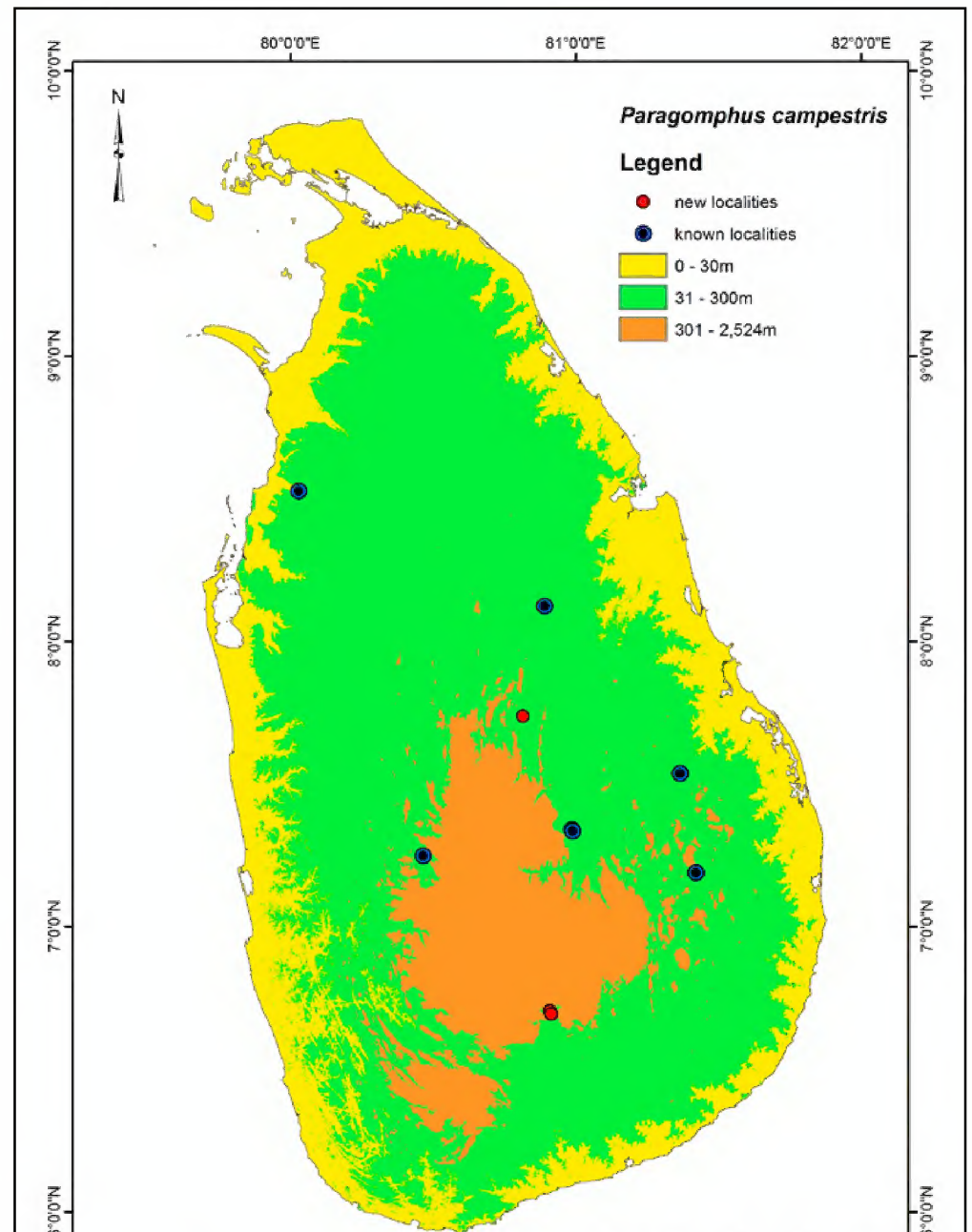

Figure 10. Distribution of *Paragomphus campestris* with new localities.

sandy river bank or on vegetation about 1.2 m above the ground. The female observed was found on a twig about 1 m above ground.

Macromia zeylanica Fraser, 1927 – endemic

NCS: Critically Endangered (MOE 2012)

GCS: Not Evaluated (IUCN 2015)

Proposed GCS: Vulnerable (Bedjanič et al. 2014)

An uncommon dragonfly species in the family Macromiidae (Carle et al. 2015) that inhabits forest streams in the wet zone (Bedjanič et al. 2014). The field identification of the species can be based on their metallic green eyes, black thorax with a bluish metallic sheen, and yellow markings including a prominent antehumeral stripe. A teneral male (Figure 11) was observed hanging from vegetation along a small irrigation canal located in the Gal Oya National Park (Monaragala district) (Figure 12).

Figure 11. *Macromia zeylanica* ♂.

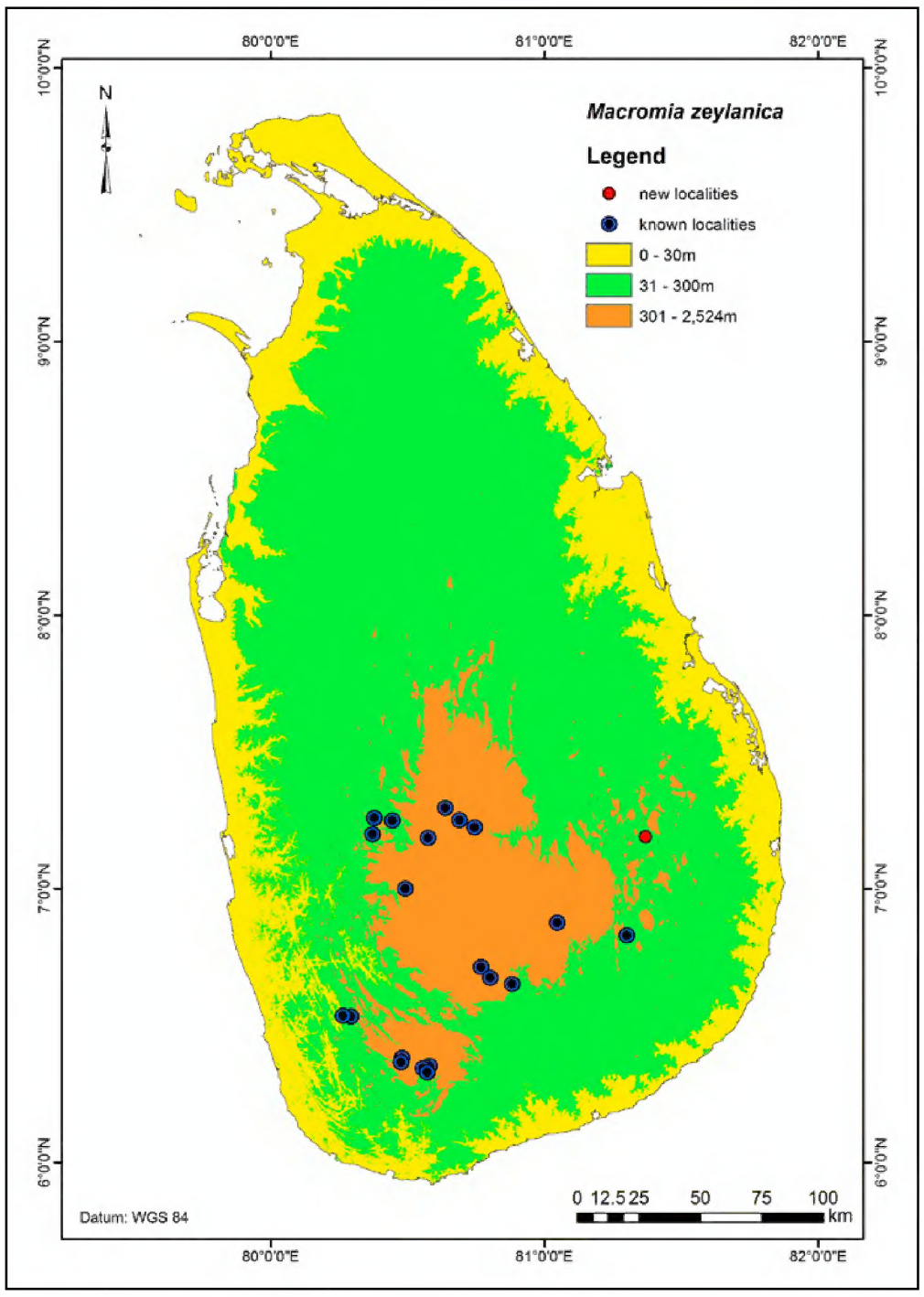

Figure 12. Distribution of *Macromia zeylanica* with new localities.

Macromidia donaldi pethiyagodai van der Poorten, 2012 – endemic subspecies

NCS: Not Evaluated by MOE (2012)

GCS: Not Evaluated (IUCN 2015)

Proposed GCS: Endangered (Bedjanič et al. 2014)

Macromidia donaldi pethiyagodai (Figure 13) is a recently described endemic subspecies (van der Poorten 2012) in the family Synthemistidae (Carle et al. 2015; Schorr and Paulson 2016). It inhabits forest streams and is known only from few localities in the wet zone and intermediate

Figure 13. *Macromidia donaldi pethiyagodai* ♀.

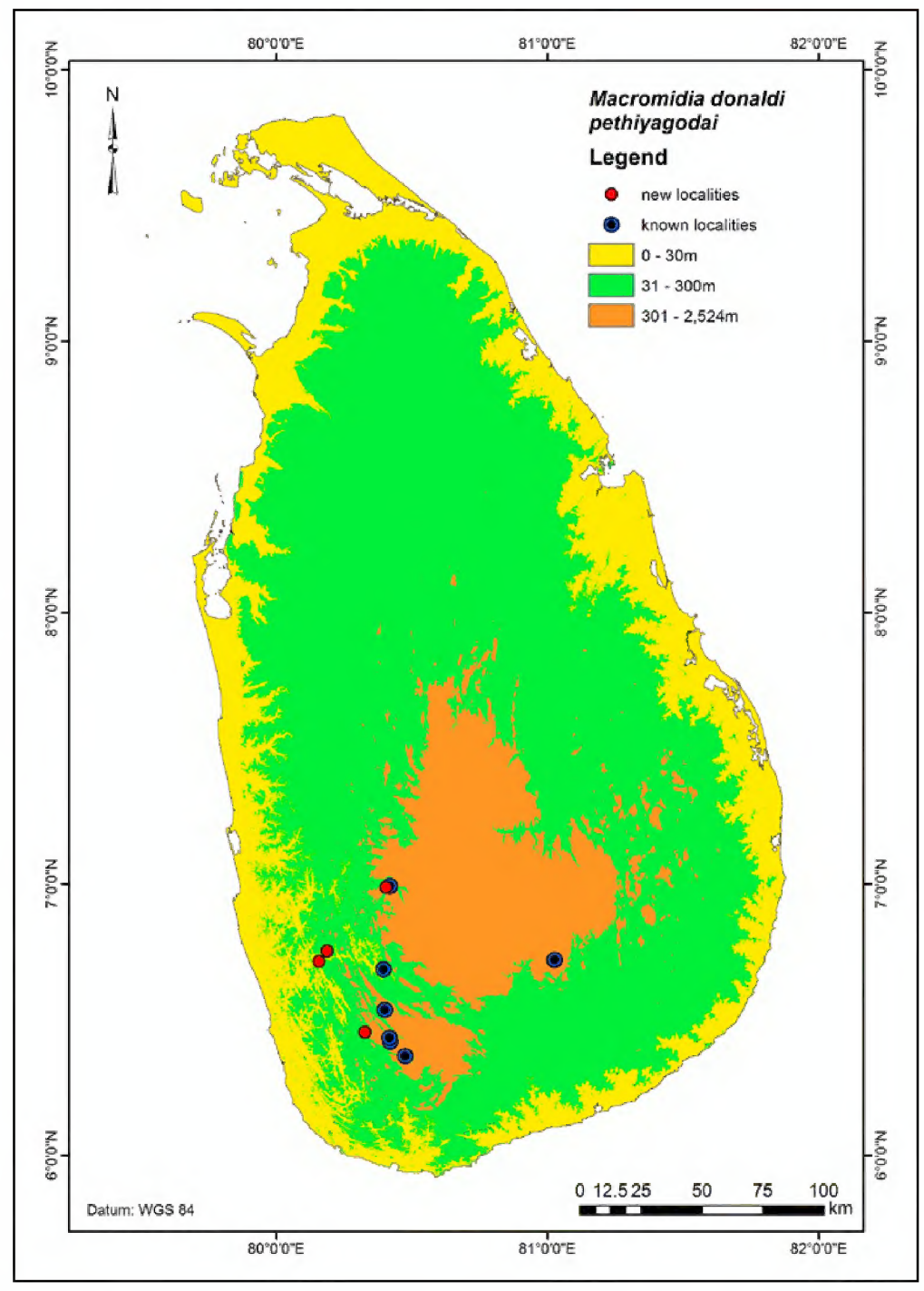

Figure 14. Distribution of *Macromidia donaldi pethiyagodai* with new localities.

zone of the island (Bedjanič et al. 2014). In the field it can be distinguished based on the metallic black thorax and the three short yellow stripes that start from the ventral side of the thorax and extend up to the middle of its lateral surface. The records presented here (Figure 14) are of a female observed close to a stream, resting on an exposed stick approximately 1 m above ground in Morapitiya-Runakanda Forest Reserve (Kalutara district), a female observed ovipositing in a very shallow sandy bottomed area along a large stream at the border of Madakada Forest Reserve (Kalutara district), a male observed resting on a twig at Dombagaskanda Forest Reserve (Kalutara district), and several males observed flying near streams at Makandawa Forest Reserve (Kegalle district).

Figure 15. *Hylaeothemis fruhstorferi* ♂.

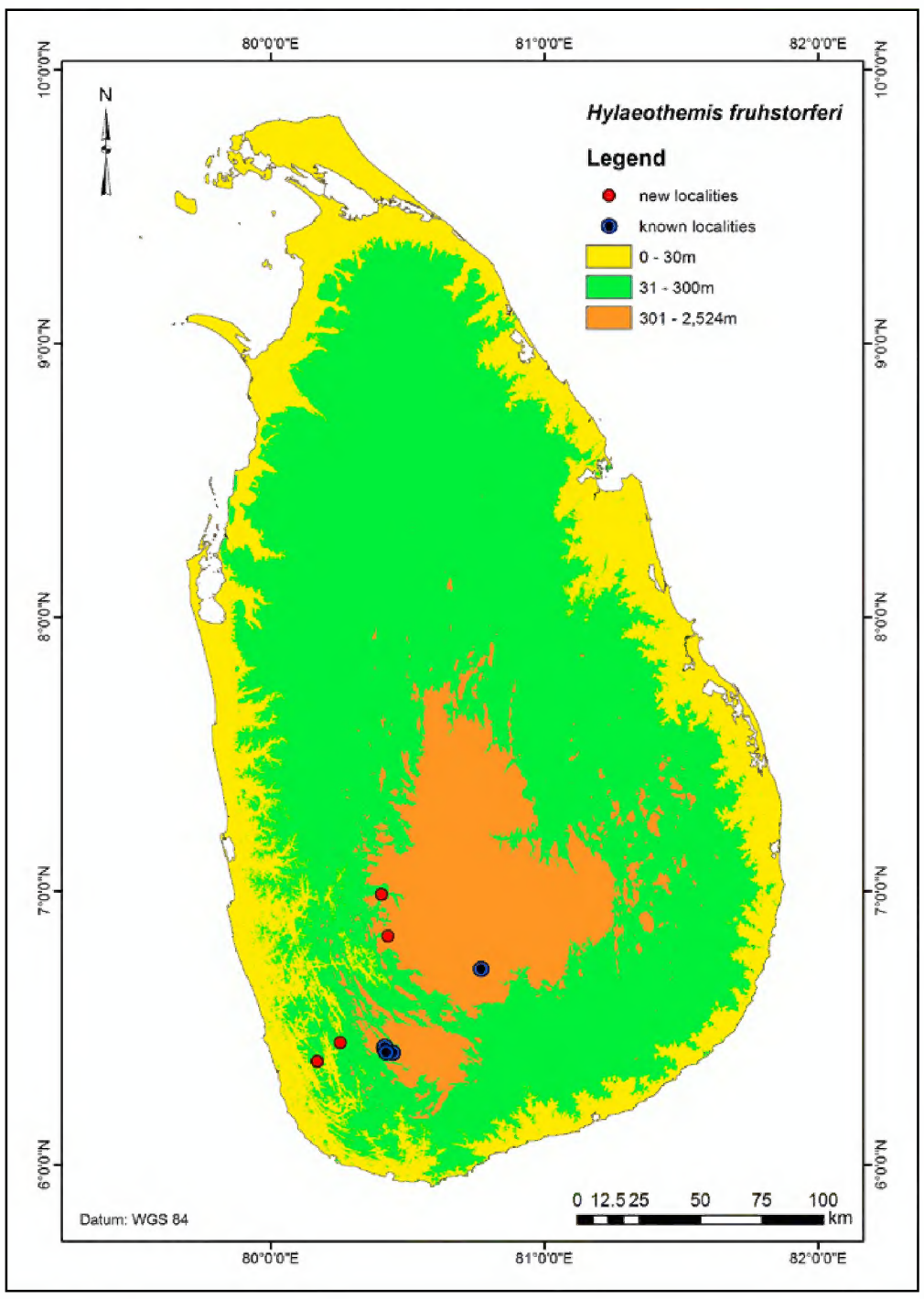

Figure 16. Distribution of *Hylaeothemis fruhstorferi* with new localities.

Hylaeothemis fruhstorferi (Karsch, 1889) – endemic

NCS: Critically Endangered (MOE 2012)

GCS: Endangered (Dow 2009)

Proposed GCS: Critically Endangered (Bedjanič et al. 2014)

This is a rare Sri Lankan species in the family Libellulidae. It was first described from Balangoda (Ratnapura district) but recently it was only known from localities around Kudawa, Sinharaja area (Bedjanič et al. 2014). *Hylaeothemis fruhstorferi* (Figure 15) can be identified in the field by its slender abdomen, metallic blue frons and black body characteristically marked in yellow or pale blue. Single males of the species were recorded from Makandawa Forest Reserve (Kegalle district), Adawikanda, Erathna (Ratnapura district), Kalugala Proposed Reserve and Yagirala Forest Reserve located in Kalutara district, extending its distribution range (Figure 16).

Tetrathemis yerburii Kirby, 1894 – endemic

NCS: Endangered (MOE 2012)

GCS: Endangered (Bedjanič 2006)

Proposed GCS: Vulnerable(Bedjanič et al. 2014)

Tetrathemis yerburii (Figure 17) is widespread across the low country and lower hills in southwestern Sri Lanka, wherever forested habitats are present (Bedjaničet al. 2014). This small dragonfly can be easily identified in the field by its metallic blue-green eyes and characteristic yellow markings on a black thorax and abdomen. The present record was reported from Gal Oya National Park (Figure 18) close to the border of the intermediate and the dry zone of the country (SLSD 2007). A single male was observed in a small stream close to the location where Gal Oya (Oya=large stream) opens to the large irrigation tank, Senanayake Samudraya (Monaragala district).

Figure 17. *Tetrathemis yerburii* ♂.

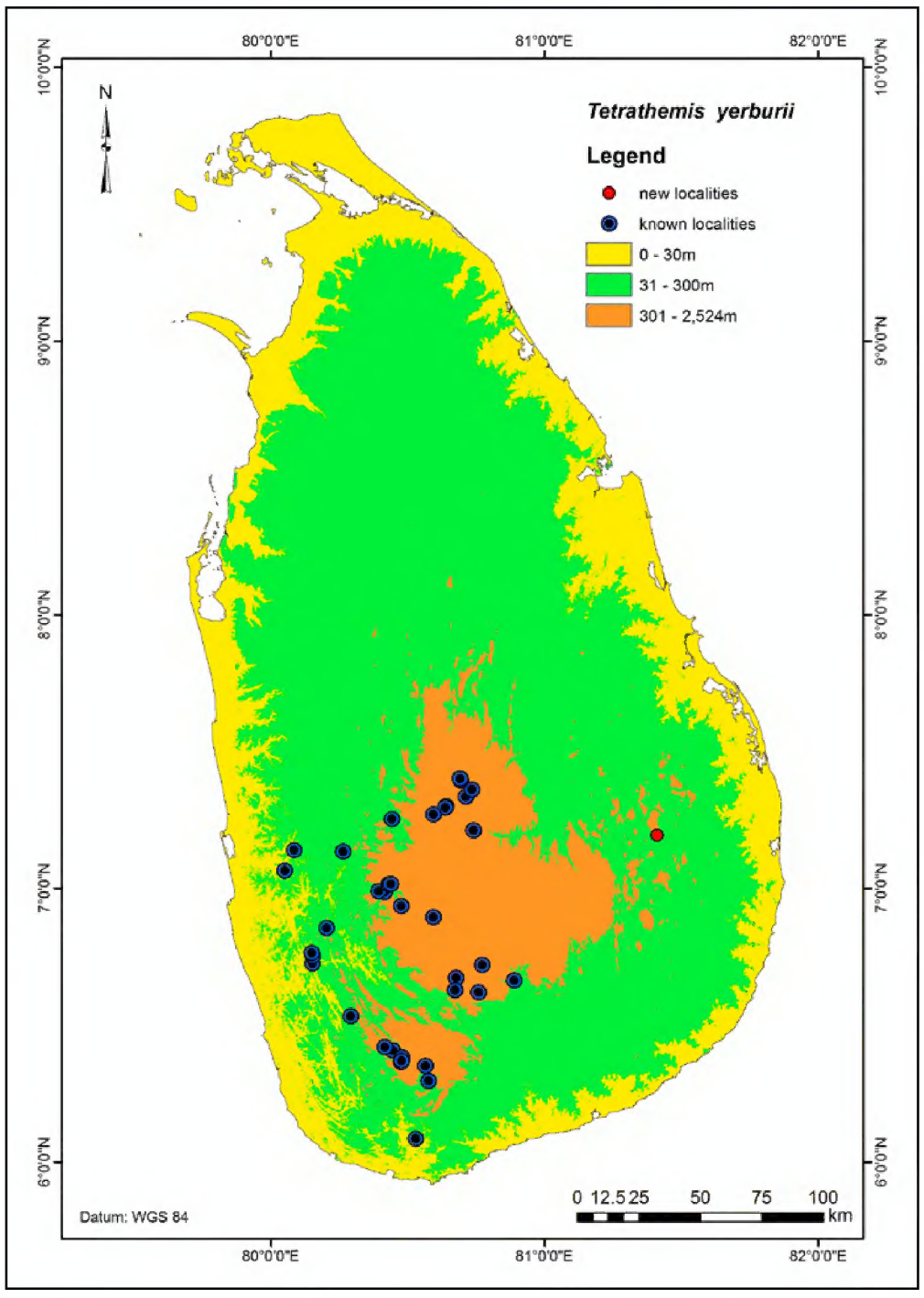

Figure 18. Distribution of *Tetrathemis yerburii* with new localities.

Cratilla lineata calverti Föster, 1903 – native non-endemic

NCS: Endangered (MOE 2012)

GCS: Not Evaluated (IUCN 2015)

Proposed GCS: Not Evaluated (Bedjanič et al. 2014)

In Sri Lanka, this is a rare species from the family Libellulidae. It can be identified in the field by its dark abdomen with thin yellow markings, characteristic yellow thoracic markings, pale colour face, and metallic blue frons. Hitherto it has only been recorded from the forests in the wet zone (Bedjanič et al. 2014). A female *Cratilla lineata calverti* (Figure 19) was observed at Ritigala (Anuradapura district) and another female was observed in a forested home garden at Hakmana (Figure 20).

Out of the 24 distribution records presented, eight were recorded outside the existing protected area network of Sri Lanka. These observations indicate that not only the protected areas are important for conservation of threatened species, but also habitats outside them. This highlights the importance of public awareness for the protection of critical habitats outside the protected areas. It also highlights the importance of incorporating non-protected areas in species surveys, so areas with rich biodiversity may be identified and included in plans to expand conservation areas.

Figure 19. *Cratilla lineata calverti* ♀.

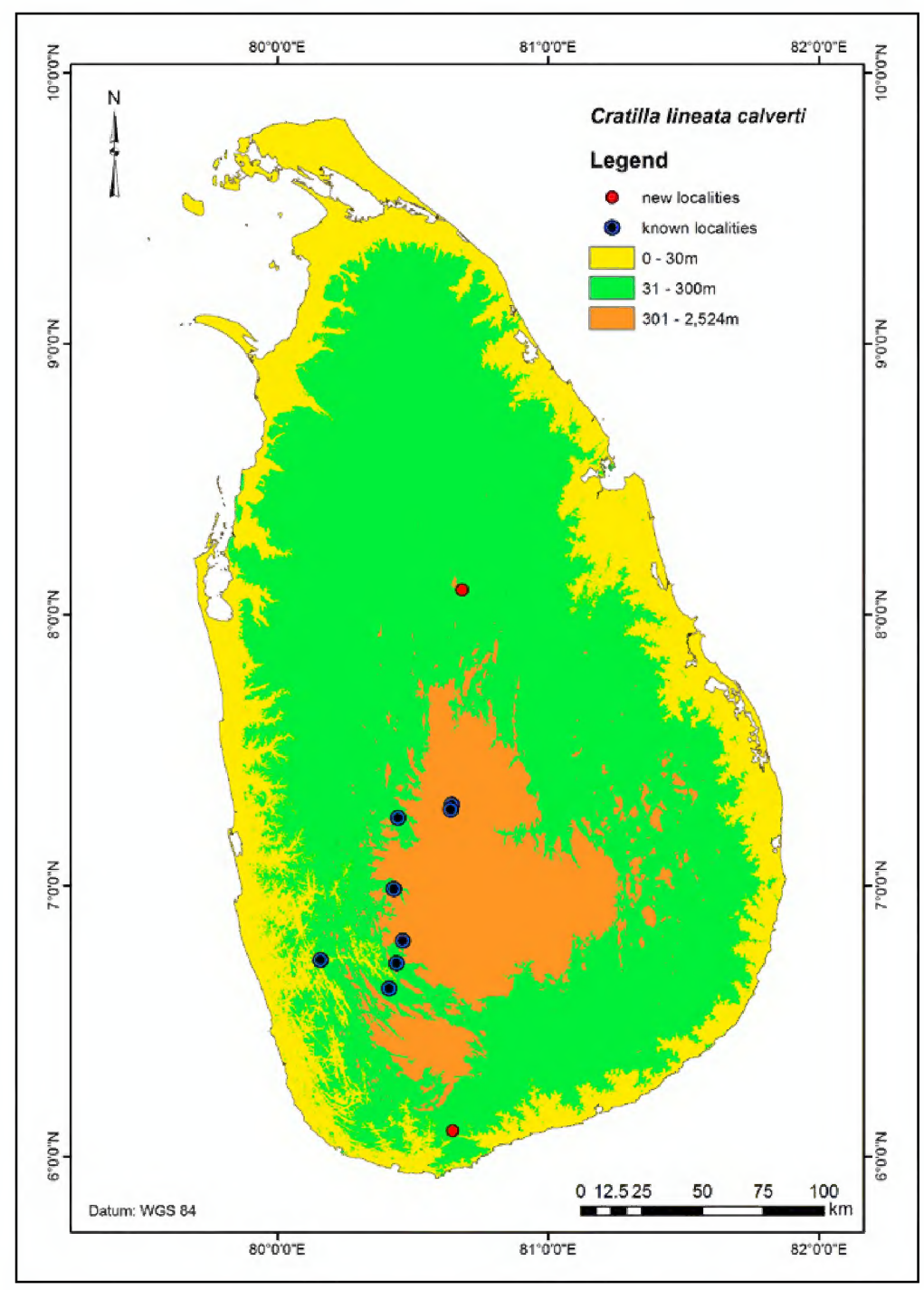

Figure 20. Distribution of *Cratilla lineata calverti* in Sri Lanka with new localities.

The record of *Cratilla lineata calverti* from Ritigala, a location within the dry zone of Sri Lanka with a microclimate comparable with the submontane area (DWC 2008), suggests that this species might also inhabit localities in the dry and intermediate zones. The record of *Tetrathemis yerburii* at the border of intermediate and dry zone of Sri Lanka also suggests that this species has a wider distribution in the intermediate zone than previously assumed. Seven of the range extensions reported here are from the intermediate zone or the dry

zone of Sri Lanka. This highlights the need for proper odonatological surveys in both climatic zones, especially in the wet habitats and riverine forests.

Most of the threatened species recorded in this study are considered rare species with few reliable distribution records, according to available literature. Three of the species observed (*A. lieftincki, P. campestris*, and *H. fruhstorferi*) are known from fewer than 10 localities at present. However, some of the known locality records of these rare species were made several decades ago (de Fonseka 2000; Bedjanič et al. 2014). Thus, it is possible that the species may no longer occur at some of the reported localities, considering the significant habitat loss that has taken place in the country during recent decades (IUCNSL and MOENR 2007). Therefore, records provided here are important for understanding the current distribution and conservation status of these rare and threatened odonates.

All observations reported agree with known flight seasons for the recorded species and many were found during peak months of activity according to previous records (Bedjanič et al. 2014). This helps delimit flight seasons and future surveys on these species will have a better chance of success if carried out in the identified flight seasons.

The new locality records and range extensions presented here reveal a gap in available information on the distribution of rare and threatened Odonata in Sri Lanka. Further odonatological surveys are necessary to more accurately define the conservation status of species. Systematic surveys are needed for protected areas and their vicinity, wet habitat patches in the dry and intermediate areas, and natural habitats outside the established protected area network. Those surveys will help to increase our understanding of the unique Sri Lankan odonate diversity.

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